CLAIMS

What is claimed is.

1. An electroless plating solution comprising:

a primary metal selected from cobalt, rhodium, iridium, nickel, palladium, platinum, copper, silver, gold, and combinations thereof;

at least one primary reducing agent;

a complexing and buffering agent consisting essentially of a single agent;

at least one pH adjusting agent;

optionally at least one surface active agent; and

the solution, reaction, and mixture products thereof.

2. The solution according to claim 1, wherein primary metal is in a concentration from about 5 gram/liter to about 35 gram/liter.

3. The solution according to claim 1, further including:

a secondary metal selected from chromium, molybdenum, tungsten, manganese, technetium, rhenium, and combinations thereof.

4. The solution according to claim 1, further including:

a secondary metal selected from chromium, molybdenum, tungsten, manganese, technetium, rhenium, and combinations thereof; and wherein secondary metal is in a concentration from about 1 gram/liter to about 30 gram/liter.

5. The composition according to claim 1, wherein the primary reducing agent includes:

a boron-containing compound in a concentration range from about 2 gram/liter to about 30 gram/liter; and further including:

a secondary reducing agent in a concentration range from about 0 gram/liter to about 2 gram/liter.

6. The composition according to claim 1, wherein the primary reducing agent includes:

a boron-containing compound in a concentration range from about 2 gram/liter to about 30 gram/liter, wherein the boron-containing compound is selected from dimethylaminoborane, diethylaminoborane, morpholine borane, and mixtures thereof; and further including:

a secondary reducing agent in a concentration range from about 0 gram/liter to about 2 gram/liter.

7. The composition according to claim 1, wherein the primary reducing agent includes:

a boron-containing compound in a concentration range from about 2 gram/liter to about 30 gram/liter, wherein the boron-containing compound is selected from dimethylaminoborane, diethylaminoborane, morpholine borane, and mixtures thereof; and further including:

a secondary reducing agent in a concentration range from about 0 gram/liter to about 2 gram/liter, wherein the secondary reducing agent is selected from ammonium hypophosphite, hypophosphites of lithium, sodium, and potassium, hypophosphites of, magnesium, calcium, and strontium, nickel hypophosphite, hypophosphorous acid, sulfites, bisulfites, hydrosulfites, metabisulfites, dithionates, tetrathionates, thiosulfates, thioureas, hydrazines, hydroxylamines, aldehydes, glyoxylic acid, reducing sugars diisobutylaluminum hydride, and sodium bis(2-methoxyethoxy)aluminum hydride.

8. The composition according to claim 1, wherein the complexing and buffering agent includes $(NH_2)SO_4$.

9. The composition according to claim 1, wherein the complexing and buffering agent includes $(NH_2)SO_4$ in a concentration range from about 80 gram/liter to about 600 gram/liter.

10. The composition according to claim 1, wherein the at least one pH adjusting agent includes tetramethylammonium hydroxide in a concentration range from about 30 mL to about 150 mL.

11. The composition according to claim 1, wherein the composition is in a pH range from about pH 7 to about pH 10.

12. The composition according to claim 1, wherein the composition is in a temperature range from about 20° C to about 60° C.

13. An electroless plating structure on a metal-six copper (M6 Cu) pad, having a composition comprising:

$pM_w sM_x B_y P_z$

wherein pM is a primary metal selected from at least one of Cu, Ag, Au, Co, Pd, Pt, Ni, Rh, and Ir;

wherein sM is a secondary metal selected from zero to at least one of Cr, Mo, W, Mn, Tc, and Re;

wherein B and P represent boron and phosphorus, respectively; and

wherein w has a range from about 0.5 to about 0.99, x has a range from about 0.0 to about 0.2, y has a range from about .01 to about 0.1, and z has a range from about 0.0 to about 0.02.

14. The electroless plating structure according to claim 13 further including a metal compound selected from CuB, CuBP, CuCrB, CuCrBP, CuMoB, CuMoBP, CuWB, CuWBP, CuMnB, CuMnBP, CuTcB, CuTcBP, CuReB, CuReBP, CuNiB, CuNiBP, CuNiCrB, CuNiCrBP, CuNiMoB, CuNiMoBP, CuNiWB, CuNiWBP, CuNiMnB, CuNiMnBP, CuNiTcB, CuNiTcBP, CuNiReB, and CuNiReBP.

15. The electroless plating structure according to claim 14, wherein Cu is substituted or accompanied by at least one of Ag and Au.

16. The electroless plating structure according to claim 13 further including a metal compound selected from NiB, NiBP, NiCrB, NiCrBP, NiMoB, NiMoBP, NiWB, NiWBP, NiMnB, NiMnBP, NiTcB, NiTcBP, NiReB, NiReBP, NiCoB, NiCoBP, NiCoCrB, NiCoCrBP, NiCoMoB, NiCoMoBP, NiCoWB, NiCoWBP, NiCoMnB, NiCoMnBP, NiCoTcB, NiCoTcBP, NiCoReB, and NiCoReBP.

17. The electroless plating structure according to claim 16, wherein Ni is substituted or accompanied by at least one of Pd and Pt.

18. The electroless plating structure according to claim 13 further including a metal compound selected from CoB, CoBP, CoCrB, CoCrBP, CoMoB, CoMoBP, CoWB, CoWBP, CoMnB, CoMnBP, CoTcB, CoTcBP, CoReB, CoReBP, NiCoB, CoPdBP, CoPdCrB, CoPdCrBP, CoPdMoB, CoPdMoBP, CoPdWB, CoPdWBP, CoPdMnB, CoPdMnBP, CoPdTcB, CoPdTcBP, CoPdReB, and CoPdReBP.

19. The electroless plating structure according to claim 18, wherein Co is substituted or accompanied by at least one of Rh and Ir.

20. The electroless plating structure according to claim 13, wherein the metal is a metal combination selected from cobalt-nickel, cobalt-nickel-silver, cobalt-nickel-silver-copper, cobalt-silver, cobalt-silver-copper, cobalt-copper, cobalt-copper-nickel, nickel-silver, nickel-silver-copper, nickel-copper, and silver-copper.

21. The electroless plating structure according to claim 13, wherein the metal is selected from MP, MB, MPB, MW, MWP, MWBP, MNiP, MNiWP, MReP, MReBP, and wherein M is a metal combination selected from cobalt-nickel, cobalt-nickel-silver, cobalt-nickel-silver-copper, cobalt-silver, cobalt-silver-copper, cobalt-copper, cobalt-copper-nickel, nickel-silver, nickel-silver-copper, nickel-copper, and silver-copper.

22. A process comprising:

combining a primary metal and ammonium sulphate in a first solution;

mixing tetramethylammonium hydroxide to the first solution to form a second solution;

first adjusting the pH and the temperature of the second solution;

mixing dimethylamine borane and ammonium hypophosphite to the second solution to form a third solution;

second adjusting the pH and the temperature of the third solution; and

applying the third solution to a substrate under conditions to cause the cobalt in the cobalt chloride to precipitate onto the substrate.

23. The process according to claim 22, wherein the cobalt in the cobalt chloride has a concentration in a range from about 1 gram/liter to about 40 gram/liter, wherein the ammonium sulphate has a concentration in a range from about 10 gram/liter to about 800 gram/liter, wherein the dimethylamine borane has a concentration in a range from about 1 gram/liter to about 30 gram/liter, wherein the ammonium hypophosphite has a concentration in a range from about 0

gram/liter to about 2 gram/liter, and wherein the tetramethylammonium hydroxide has a volume in a range from about 30 gram/liter to about 150 gram/liter, when added to a 100 ml bath.

24. The process according to claim 22, wherein applying includes:

forming a first lamella including a primary metal and an upper lamella, wherein phosphorus has a greater concentration in the upper lamella than in the first lamella.

25. A process comprising:

in solution, combining cobalt chloride, ammonium sulphate, tetramethylammonium hydroxide, dimethylamine borane, and ammonium hypophosphite;

adjusting the pH to a range from about pH 7 to about pH 10;

adjusting the temperature to a range from about 20° C to about 60° C; and

applying the solution to a substrate under conditions to cause the cobalt in the cobalt chloride to deposit onto the substrate.

26. The process according to claim 25, wherein the cobalt in the cobalt chloride has a concentration in a range from about 1 gram/liter to about 40 gram/liter, wherein the ammonium sulphate has a concentration in a range from about 10 gram/liter to about 800 gram/liter, wherein the dimethylamine borane has a concentration in a range from about 1 gram/liter to about 30 gram/liter, wherein the ammonium hypophosphite has a concentration in a range from about 0 gram/liter to about 2 gram/liter, and wherein the tetramethylammonium hydroxide has a volume in a range from about 30 gram/liter to about 150 gram/liter when added to a 100 ml bath.

27. The process according to claim 25, wherein applying includes:

forming a first lamella including a primary metal and an upper lamella, wherein phosphorus has a greater concentration in the upper lamella than in the first lamella.

28. An article comprising:

a conductive substrate;

a first lamella disposed above the conductive substrate including a composition according to the formula $pM_w\,sM_x\,B_y$

wherein pM represents from one to nine primary metals, selected from Cu, Ag, Au, Ni, Pd, Pt, Co, Rh, and Ir, wherein sM represents from zero to six secondary metals, selected from Cr, Mo, W, Mn, Tc, and Re, and wherein B_y represents boron; and

wherein w has a range from about 0.5 to about 0.99, x has a range from about 0.0 to about 0.2, and y has a range from about .01 to about 0.1.

29. The article according to claim 28, further including:

a second lamella disposed above the first lamella including a composition according to the formula $pM_w\,sM_x\,B_y\,P_z$

wherein P_z represents phosphorus; and

wherein z has a range from about 0.0 to about 0.02.

30. The article according to claim 28, further including:

a second lamella disposed above the first lamella including a composition according to the formula $pM_w\,sM_x\,B_y\,P_z$;

a third lamella disposed above the second lamella including a composition according to the formula $pM_w sM_x B_y P_z$; and

wherein the concentration of P in the third lamella is greater than the concentration of P in the second lamella.